NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

January 18, 2005

Group Chairman's Factual Report

OPERATIONS/HUMAN PERFORMANCE GROUP

DCA05MA003

A. ACCIDENT

Operator: Pinnacle Airlines, Inc., DBA Northwest Air Link
Location: West of Jefferson City Airport
Date: October 14, 2004
Time: 2215 Central Daylight Time[1] (CDT)
Airplane: Bombardier CL-600-2B19, N8396A, Serial # 7396

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[1] All times are Central Daylight Time based on a 24-hour clock, unless otherwise noted. Actual time of accident is approximate.

C. Summary

On October 14, 2004, at about 2215 central daylight time (CDT), N8396A, a Bombardier CL-600-2B19 operating as Pinnacle Airlines flight 3701 (d.b.a. Northwest Airlink) crashed in a residential area in Jefferson City, Missouri, about 2.5 miles south of the Jefferson City, Missouri, airport (KJEF). Impact forces and a post crash fire destroyed the airplane. The two crewmembers were fatally injured. The flight was a repositioning[2] flight from Little Rock, Arkansas (KLIT) to Minneapolis-St. Paul, Minnesota (KMSP). There were no passengers on board. There were no injuries on the ground.

D. Details of the Investigation

The Operations / Human Performance Group convened at the Jefferson City Police Headquarters, Jefferson City, Missouri, on October 15, 2004, to begin the field phase of the accident investigation. The following interviews and activities were conducted:

- 10/15/04: Interviewed a captain who had previously flown the accident airplane and the manager of the Flight Operations Quality Assurance (FOQA) Program.

- 10/16/04: Interviewed a witness to the accident, a captain / checkairman who had previously been the manager of the FOQA Program, and a simulator instructor.

- 10/17/04: Interviewed the chief pilot from Bombardier, Inc., the captain who flew the accident airplane immediately prior to the accident, four KLIT Northwest customer service agents who saw the accident pilots the night of the accident, and the KLIT fueler who fueled the accident airplane.

- 10/18/04: Operations / Human Performance Group traveled to Pinnacle Headquarters in Memphis, Tennessee (KMEM), to continue the interview process.

- 10/19/04: Interviewed two simulator instructors, one ground instructor, and a Pinnacle aircrew program designee (APD), all of whom had contact with one of the accident crewmembers.

- 10/20/04: Interviewed two simulator instructors, one first officer (FO), and one checkairman, all of whom had contact with one of the accident crewmembers.

- 10/21/04: Interviewed four checkairmen, all of whom had contact with one of the accident crewmembers and the Federal Aviation Administration (FAA) aircrew program manager (APM) assigned to the Pinnacle certificate. Observed various Pinnacle procedures in CL-65 simulator (See Section O of this report for details).

[2] A flight with neither passengers nor cargo on board. The purpose is to relocate the airplane to the station where the next passenger flight is scheduled for that airplane.

- 10/22/04: Interviewed two captains, three checkairmen and one FO, all of whom had contact with one of the accident crewmembers. Interviewed the FAA principal operations inspector (POI) assigned to the Pinnacle certificate.

Obtained reference manuals, records, and other pertinent documents from Pinnacle Airlines and the FAA.

The Operations / Human Performance Group concluded the initial field phase of the accident investigation on October 22, 2004.

The Operations / Human Performance Group reconvened on November 30, 2004, to continue the field phase of the investigation. The following interviews and activities were conducted:

- 11/30/04: Interviewed vice president (VP) of Human Resources, VP of Safety, Director of the Corporate Education Center, and the CRJ Program Manager.

- 12/01/04: Interviewed the VP of Flight Operations, a line captain, Flight Operations Administrator, Manager of Crew Planning, cockpit resource management (CRM) Instructor / Developer, and a former FAA Acting POI (APOI) assigned to the Pinnacle certificate.

- 12/02/04: Interviewed a ground instructor, simulator instructor, the Detroit, Michigan (KDTW) Base Manager, FAA flight standard district office (FSDO) Manager, another former FAA APOI assigned to the Pinnacle certificate, and the former FAA POI assigned to the Pinnacle certificate for over 15 years.

- 12/03/04: Interviewed the chief pilot and the KMEM Base Manager.

The Operations / Human Performance Group concluded the second field phase of the accident investigation on December 3, 2004.

E. History of Flight

The accident crewmembers were on airport standby in KDTW on October 14, 2004. Crew scheduling notified them around 1700 that they were to deadhead[3] to KLIT on flight 5809, reposition aircraft N8396A from KLIT to KMSP, and remain there overnight. Flight 5809 departed DTW at 1919 and arrived about 2040 in KLIT.

Northwest Airlines, Inc., (NWA) provided ground support for Pinnacle in KLIT. An NWA customer service agent met flight 5809 and spoke with the accident crew after they deplaned. The NWA agent stated that the three of them engaged in "small talk" for a short period of time before he gave the captain the paperwork for the flight to KMSP. He said that both crewmembers "Appeared to be in a great mood and did not seem tired." Another NWA agent, who briefly spoke with the accident captain, stated, "He looked fine and did not appear tired." The accident flight departed KLIT at 2058 on an IFR flight plan to

[3] Traveling on a flight as a non-revenue passenger.

KMSP. The flight plan indicated that the cruise altitude was planned for best fuel burn at FL330 but, for some reason, the crew decided to climb to FL410.

A review of air traffic control (ATC) conversations with the accident flight indicated that at 2152:08, the airplane was level at FL410. At 2154:31, the crew notified ATC that they would be unable to remain at FL410 and requested lower. The controller told the crew to stand by.

The controller attempted to recontact the crew at 2154:53. Shortly thereafter at 2155:05, the crew declared an emergency.

A review of data obtained from the flight data recorder (FDR) indicated that the flight was able to maintain FL410 for about 3½ minutes prior to the onset of the stick shaker[4]. About 20 seconds later, the airplane was in a 32-degree nose down pitch attitude and an 80-degree left bank. During those 20 seconds, FDR data indicated that the stick shaker and stick pusher[5] were activated a total of four times. About one second later, the FDR ceased operation, however, the cockpit voice recorder (CVR) continued to function.

At 2159:50, the crew requested and received clearance to descend to 13,000[6] feet mean sea level (MSL). The crew did not explain to ATC the nature of their emergency.

During the descent, the FDR resumed operation at FL290. It indicated that the auxiliary power unit (APU) was supplying electrical power to the airplane and the airspeed was 178 knots. Additionally, the N2[7], oil pressure, and fuel flow all indicated zero on both engines.

At 2203:14, ATC queried the crew as to the nature of their emergency. The crew informed ATC, "We had an engine failure up at that altitude and the airplane went into a stall with that engine failure so we are in a descent now to start our other engine."

At 2203:29, the crew advised the controller they were continuing the descent to 13,000 feet to start the other engine. The controller acknowledged that he understood the crew was in "controlled flight with a single engine" and that information would be passed to the next controller. At 2206:49, the crew advised ATC to stand-by while they were " going to start this other engine and make sure everything is okay."

At 2206:37, the crew requested and received clearance from ATC to descend to 11,000 feet.

At 2208:03, the crew informed ATC that they had a double engine failure and requested a direct vector to any airport. The controller began to vector the airplane to KJEF and assisted the crew with the current landing runway (runway 30), the local altimeter and the instrument landing system (ILS) approach frequency for runway 30.

[4] Vibration felt in both control columns to warn the pilots of an impending stall.
[5] Automatically "pushes" the control column forward (nose down) to prevent a stall.
[6] Maximum altitude for engine starts using APU bleed air.
[7] Speed of the engine's compressor section.

At 2214:32, ATC lost contact with the flight. The airplane impacted the ground about 2½ miles south of KJEF.

F. Flight Crew Information

The captain and first officer were certificated, current, and qualified in the CL-65 in accordance with Pinnacle Airlines and FAA requirements. A review of FAA accident / incident and enforcement records of both flight crewmembers indicated that there was no history of certificate actions filed against either pilot.

1.0 Captain: Jesse Rhodes

Date of Hire:	02/24/03
FAA Certificates:	**Airline Transport Pilot** (Airplane Multi-Engine Land, CL-65, BE-1900), Commercial Privileges (Airplane Single Engine Land) BE-1900 Second in Command Required CL-65 Circling Approach-VMC[8] Only

Captain Rhodes received his private pilot certificate, airplane single engine land, on August 16, 1991. He added an instrument rating to that certificate on January 20, 1993.

He was issued a commercial pilot certificate, airplane single engine land / instrument airplane, on October 25, 1993. He added a multiengine land rating to that certificate on May 4, 1994.

Captain Rhodes received a Notice of Disapproval following his FAA checkride for a certified flight instructor (CFI) certificate, airplane multi-engine, in 1995[9]. He received a second Notice of Disapproval following his FAA checkride for that same certificate on September 4, 1995. The areas of the checkride that were unsatisfactory included maneuvering with one engine inoperative and go-around. He was subsequently issued a flight instructor certificate, airplane multi-engine, on October 18, 1995. He added single engine land to his CFI certificate on October 22, 1995.

Captain Rhodes received a Notice of Disapproval following his FAA checkride for a CFI certificate, instrument airplane, on October 29, 1995. The Notice of Disapproval indicated a deficiency in "publications related to instrument flight." He was subsequently issued that certificate on November 9, 1995.

He successfully renewed his CFI certificate on October 16, 1997, November 9, 1999, November 26, 2001, and November 28, 2003[10].

Captain Rhodes failed his initial BA-4100 first officer oral at Trans States Airlines on September 25, 1998. On that same date, he failed his initial BA-4100

[8] Visual Meteorological Conditions.
[9] The FAA could not provide a copy of that Notice of Disapproval indicating the date and areas of deficiency.
[10] Flight instructors are required by the FAA to renew their CFI certificates bi-annually.

first officer simulator checkride. The areas of the checkride that were unsatisfactory were: Approaches to stalls, specific flight characteristics of inflight maneuvering, localizer back course instrument approach, and zero flap approach. He subsequently completed his first officer qualifications later that day. On May 3, 2000, he received a termination letter from the flight manager at Trans States Airlines. The reasons listed for termination were: "Excessive abuse of sick leave, unable to contact while on reserve, and attending a training event at another airline while still employed with Trans States Airlines."

He received a Notice of Disapproval following his FAA checkride for an airline transport certificate (ATP) and BE-1900 type rating on May 16, 2000. He was subsequently issued an ATP certificate and BE-1900 type rating on August 27, 2000.

At the time of the accident, Captain Rhodes held a First Class medical certificate dated July 22, 2004, with the following restriction: "Holder must wear corrective lenses."

According to Pinnacle Airlines' employment and flight records, Captain Rhodes had accumulated / completed the following flight times and training prior to the accident:

Total flight time:	6,900 hours
Total time with company:	973 hours
Total CL-65	973 hours
Total pilot-in-command (PIC) time:	5,055 hours
Total PIC CL-65	150 hours
Total flying time last 24 hours:	0 hours
Total flying time last 30 days:	75 hours
Total flying time last 90 days:	154 hours
Total flying time last 12 months:	667 hours

Initial CL-65 type rating:	08/10/04
Most recent recurrent ground training prior to the accident:	12/08/03
Most recent proficiency check prior to the accident:	08/10/04
Most recent line check prior to the accident:	08/26/04

2.0 First Officer: Peter Richard Cesarz

Date of Hire:	04/26/04
FAA Certificates:	**Commercial Pilot** (Airplane Single and Multi-Engine Land, Instrument Airplane)

First Officer Cesarz received his private pilot certificate on November 15, 2002. He added an instrument rating to that certificate on January 24, 2002.

He received a Notice of Disapproval following his FAA checkride for a commercial pilot certificate, multi-engine land, on March 5, 2003. The Notice of Disapproval indicated that the entire flight portion of the checkride would have to be

repeated. First Officer Cesarz was subsequently issued that certificate following a recheck on March 6, 2003.

A simulator instructor, who gave First Officer Cesarz a portion of his simulator training, stated that he displayed a good attitude and he was a good pilot. He said First Officer Cesarz was someone he would not be concerned about and would make a fine captain in the future.

At the time of the accident, First Officer Cesarz held a First Class medical certificate dated July 25, 2003, with the following restriction: "Must wear corrective lenses."

According to Pinnacle Airlines' employment and flight records, First Officer Cesarz had accumulated / completed the following flight times and training prior to the accident:

Total flight time:	761 hours
Total CL-65	222 hours
Total second-in-command (SIC) time:	222 hours
Total flying time last 24 hours:	0 hours
Total flying time last 30 days:	60 hours
Total flying time last 90 days:	192 hours
Total flying time last 12 months:	380 hours

Initial FO proficiency check:	06/27/04

G. Airplane Information: Weight and Balance

Operating Empty Weight (OEW)	31,436
Passenger Weight	0
Baggage/Cargo Weight (Manifest)	0
Zero Fuel Weight	31,436
Maximum Zero Fuel Weight	44,000
Fuel Weight	8,100
Ramp Weight	39,536
Maximum Ramp Weight	53,250
Taxi Fuel Burn	200
Actual Takeoff Weight	39,336
Maximum Takeoff Weight	53,000
Estimated Fuel Burn to Accident Site	2,200
Estimated Landing Weight	35,900
Maximum Landing Weight	47,000
Takeoff Center of Gravity (CG)	21.6% MAC
Takeoff CG Limits	9.0 – 35.0
Takeoff Stab Trim	6.0
Takeoff Flap Setting	20 degrees
V Speeds	V1 115, VR 117, V2 127

H. Captain Rhodes' Upgrade Training at Pinnacle

1.0 A simulator instructor, who conducted Captain Rhodes' captain upgrade simulator periods four and five, said that he had concerns because Captain Rhodes was not performing checklists in accordance with company procedures. He also had a concern that he did not always use the correct checklist. He stated that for example, the Pinnacle checklists were typically used in conjunction with engine indicating and crew alerting system (EICAS) messages. Pilots would read the EICAS message and call for the checklist noted in the message. The checklist would then guide the pilots through a sequence of events to resolve the problem. He said that Captain Rhodes had a propensity to misidentify the checklist. Even though he would see the appropriate checklist in the EICAS message, he would call for the wrong checklist.

He further stated that when reading a checklist, Captain Rhodes would sometimes misstate the status of an item. Additionally, he would sometimes read a checklist item and action but not accomplish it or he would take action on the opposite airplane system instead of the system noted in the checklist.

The simulator instructor said that he had seen those types of deficiencies during training with FO candidates but it was unusual to see them from a captain in upgrade training. His concerns regarding Captain Rhodes' deficiencies manifested themselves during simulator session four and were validated in simulator session five. He said that he debriefed Captain Rhodes on both occasions. He said that the biggest weakness he saw in Captain Rhodes was critical decision-making and judgment; however, he flew the airplane just fine.

2.0 Another simulator instructor said he had no recollection of Captain Rhodes ever rushing checklists. He said that his judgment in the simulator environment was very sound. Generally speaking, he said that Captain Rhodes' judgment was above average and his command authority was very acceptable.

Although he could not specifically remember an engine and relight scenario with Captain Rhodes, he said that the training syllabus and profiles were always adhered to. He did not recall any problems with Captain Rhodes in those areas.

3.0 A checkairman who conducted part of Captain Rhodes' upgrade operating experience (OE) stated that the profile he looked for in upgrading captains was proficiency, judgment, initiative, leadership in setting the pace, deliberate / thoughtful actions with no knee jerk type actions, and no rushing. Captain Rhodes displayed that profile.

4.0 Captain Rhodes' simulator partner, also an upgrading captain, stated that they were together the entire time during upgrade training with the exception of simulator period six (additional training for Rhodes) and Rhodes' checkride. During simulator period five, he said that Captain Rhodes executed a non-directional beacon (NDB) approach and another approach that were unsatisfactory. He could not recall exactly Rhodes' deficiencies during the approaches, but thought it had something to do with the missed approach. The instructor told Rhodes that even though the two approaches would not have been satisfactory for a checkride, he believed that Rhodes would not have a problem if he

were signed off to take the checkride. However, the instructor suggested that Rhodes take additional training (period six) to polish his skills prior to the checkride.

He said that to his knowledge, all checklists during their training were performed in accordance with company procedures. During the simulator debriefing sessions, the instructor never made any negative comments regarding Rhodes' command presence or decision-making. He further stated that Rhodes' crew resource management (CRM) skills were fine.

I. Flight Management System (FMS) Use Above FL 360

The Pinnacle Airlines FCOM, Volume 2, Operating Limitations, pages 30-31[11] stated in part:

FMS thrust, range, and fuel management information is advisory only.

The FMS calculated thrust setting must not be used if the pressure altitude is greater than 36,000 feet.

The chief pilot for Bombardier stated that the FMS thrust settings were advisory only and that was stated in the Bombardier and Pinnacle FCOM. The only certified FMS thrust limits that were presented through the FMS were for takeoff, go around, and maximum continuous power (MCT). Climb and cruise thrust settings were not certified information in the FMS and that was the reason that they were "advisory only." However, he further stated that the FMS climb and cruise thrust settings were quite accurate and within 0.2 per cent of the charted numbers.

He said that in his experience with startup operators, the FMS was used most of the time to generate thrust settings below FL360. He further stated that both Bombardier and Collins, the FMS manufacturer, were aware of the FMS inaccuracies above FL360 and that was the reason for the FMS restriction stated in the Operating Limitations Section of the FCOM.

The investigation determined that there was confusion amongst the instructor and pilot groups regarding the FMS limitation above FL360. Some were aware of the limitation while others were not.

J. High Altitude Climbs

1.0 Interviews with simulator instructors determined that high altitude climbs and recommended climb profiles were neither conducted nor demonstrated during any of the simulator periods. However, simulator instructors did discuss those items during the pre / post simulator briefings. The company lists three climb profiles in the Maneuvers Section of the flight crew operating manual (FCOM) 2: High Speed 320 / .77M, Normal Speed 290 / .74M, and Long Range 250 / .70M. Vertical speed during the climb should be 300 FPM or less in order to maintain airspeed at or above 250 / .70M.

[11] See Attachment 5.

A review of FDR data indicated that the airplane climbed from FL370 to FL410 at an airspeed that decreased from 203 / .63M at the start of the climb to 163 / .57M as the airplane leveled at FL410. The vertical speed during the climb was 500 FPM. When the airplane was level at FL410, the airspeed gradually decayed to 150 knots just prior to the stick shaker.

Subsequent to the accident, the company added the following restriction to the Limitations Section of FCOM 2: *Minimum climb profile speed above 10,000 feet MSL will be 250 / .70M whichever was lower.* The company also revised the CRJ instructor guide[12] to include more specific high altitude climb information and procedures. Additionally, Bombardier, Inc., issued an All Operator Message[13] that stated in part: *Climb profiles as detailed in the AFM must be strictly adhered to. Climbing below the recommended profile speed may place the airplane behind the energy curve when it arrives at the desired altitude and it may not be capable of remaining at that altitude. This may be evident by an aircraft nose-high attitude and its failure to accelerate.*

2.0 Interviews with ground instructors determined that high altitude climbs, recommended climb profiles, and airplane altitude and climb capability charts[14] were discussed in the jet-upset and performance modules of Aircraft Ground / General Operational Subjects. The altitude and climb capability charts were found in the performance section of FCOM 2, which was carried by each pilot. The pilot was required to consult those charts anytime a flight was assigned an altitude above FL360 due to FMS limitations[15]. An additional procedure that could be used as a quick reference for the maximum altitude achievable on any given flight was to enter the proposed altitude in the FMS. An *Unable Cruise Altitude* message would be displayed on the FMS screen if current conditions prevented flight at the proposed altitude. However, company procedure always required pilots to consult the FCOM 2 altitude and climb capability charts prior to climbing to any altitude to which they had not been given planned flight performance information. That information, if available, would be part of the flight release paperwork prepared by the dispatcher and received by the crew prior to takeoff.

Analysis of the CVR, recovered from the accident airplane, was unable to verify if the accident crew consulted the FCOM altitude and climb capability charts prior to initiating the climb to FL 410.

Subsequent to the accident, the company added the FCOM 2 altitude and climb capability charts to the quick reference handbook (QRH) for easy pilot reference.

J. Operations at FL410

1.0 Interviews with checkairmen, simulator instructors and pilots determined that operations at FL410 were neither discussed nor demonstrated during any ground or simulator segment of training. However, the FOQA manager stated that the CRJ service

[12] See Attachment 8.
[13] See Attachment 7.
[14] See Attachment 6.
[15] See Section I of this report for additional information.

ceiling[16] was discussed during ground school. The service ceiling of the airplane was also found in the Limitations Section of FCOM 2.

Several checkairman, simulator instructors and pilots were interviewed regarding operations at FL410. It was determined that FL410 was only achievable when the airplane was flown with no passengers or cargo, that is, a repositioning flight. Several of the pilots stated that even though they had been able to climb to FL410, they could not remain there for an extended period of time due to deteriorating performance. One pilot stated that flight at FL410 usually was just below the high-speed warning (clacker) and just above or right at the green line[17].

One simulator instructor stated that flight at FL410 required "extreme attention." Another simulator instructor stated, "FL410 was not an altitude you wanted to be at very often."

A review of FDR data indicated that the airplane angle of attack at FL410 was initially 5.7 degrees. The stick shaker was activated when the angle of attack increased to about 12 degrees.

Subsequent to the accident, Pinnacle issued Alert Bulletin 04-54[18] that advised flight crews to no longer accept or request an ATC clearance above FL370. Additionally, Bombardier, Inc., issued an All Operator Message[19] that stated in part:

Situational awareness must be maintained at all times when the aircraft reaches the desired cruising altitude. If the nose attitude (angle of attack) is excessively high, the performance may be such that the aircraft is not capable of maintaining the altitude and the airspeed may begin to decay. Under these circumstances, a descent must be initiated immediately.

The autopilot should be engaged and performance closely monitored during the upper portion of the climb and immediately following the level off. When the selected altitude is reached, under normal conditions, the aircraft will accelerate to the desired cruise speed.

2.0 Investigators formed the impression that there was a sense of allure to some pilots to cruise at FL410 just to say they had, "Been there and done that." Pinnacle's chief pilot said that he had first learned of such "rumors" subsequent to the accident. One company FO said he would have wanted to climb to FL410 but was never able to because the airplane was always too heavy. However, he said that was only for a more efficient fuel burn and for no other reason. Another FO said that she did not see FL410 as "Any particular goal to achieve."

[16] The maximum altitude above sea level that an airplane is able to maintain horizontal flight under standard atmospheric conditions.
[17] A low-speed awareness cue, which is 25% above, stuck shaker speed. It is continually calculated, and is based on current aircraft configuration (i.e., flaps and landing gear) and flight conditions (i.e., bank angle, g-force). It is used for reference only. It is also referred to as the Stall Speed Indicator.
[18] See Attachment 9.
[19] See Attachment 7.

A management pilot interviewed from another company with a CRJ fleet stated, "Repositioning flights seemed to bring out the worst in their company's pilots." He explained that after a review of FDR data from repositioning flights, high angles of banks and steep descents often were observed. He said that pilots would take the opportunity to perform excessive maneuvers that they could not perform with passengers on board.

K. Jet Upset Training

Jet upset training was taught to initial new-hire pilots during the General Operational Subjects Module of the Aircraft Ground Training Curriculum[20] and during the second simulator-training period[21]. A Pinnacle Airlines Jet Upset Student Guide[22] was distributed to each pilot during initial ground school.

Interviews with Pinnacle's ground and simulator instructors determined that jet upset training consisted of six hours of ground school and about 20 minutes of training in the simulator. The ground school portion included subjects such as swept wing design characteristics and high altitude aerodynamics. The simulator period was conducted at FL350. However, due to time constraints, the simulator was positioned at FL350 rather than have the pilot actually practice high altitude climb techniques. Once at FL350, there was a Mach tuck[23] demonstration, Mach buffet[24] demonstration, and recoveries from unusual attitudes were conducted. Dutch rolls were not demonstrated and even though the "coffin corner"[25] was discussed, recovery from that flight regime was not part of the simulator syllabus.

The Bombardier chief pilot stated that one of simulator sessions taught by instructors at Bombardier consisted of high altitude flight at FL390. The pilot was able to observe the convergence of the high and low speed cues and then would initiate banked level turns to activate the stick shaker. He said it was a brief but effective demonstration.

Subsequent to the accident, the company revised the jet-upset portion of the instructor guide[26], jet upset student guide[27], and the ground-training curriculum to include more detailed information regarding the airplane's handling qualities at high altitude.

L. Dual Engine Flameout

[20] See Attachment 3.
[21] See Attachment 3.
[22] See Attachment 4.
[23] The tendency of an airplane to pitch down due to loss of downwash on the tail when the critical Mach number is exceeded.
[24] The airflow separation behind a shock-wave pressure barrier caused by airflow over flight surfaces exceeding the speed of sound.
[25] A term used to describe operations at high altitudes where low indicated airspeeds yield high true airspeeds (MACH number) at high angles of attack. The high angle of attack results in flow separation, which causes buffet. Turning maneuvers at these altitudes increase the angle of attack and result in stability deterioration with a decrease in control effectiveness. The relationship of stall speed to the critical MACH airspeed narrows to a point where sudden increases in angle of attack, roll rates, and/or disturbances; e.g., clear air turbulence, cause the limits of the airspeed envelope to be exceeded.
[26] See Attachment 10.
[27] See Attachment 11.

The Pinnacle Airlines CRJ Flight Crew Operating Manual (FCOM), Volume 2, Emergency Procedures, pages EC8-13[28] stated in part:

Double Engine Failure (In Flight)

CONT IGNITION	*ON*
Thrust Levers (Both)	*If engines continue to run down, SHUTOFF*
ADG Manual Deploy Handle	*PULL*
Stab Trim CH2 switch	*ENGAGE*
Target Airspeed	*ESTABLISH*
Above FL340	*0.7 MACH*
Below FL340	*240 KIAS*

Maintain airspeed until ready to restart engines.

The above checklist items were performed by the pilot flying (PF) as memory items and then the pilot not flying (PNF) would read / do the rest of the checklist, which was found in the QRH.

The investigation determined after interviews with the CRJ program manager, checkairmen, simulator instructors and pilots[29] that a double engine failure training scenario was not given to the pilots during simulator training and there was no training scenario given with the air driven generator (ADG) deployed. The checklist items found in the QRH for a double engine failure were discussed in ground school and during one of the simulator briefings. Additionally, pilots were required to pass a written test on all checklist memory items and the memory items were also covered during a portion of the oral examination following ground school.

Subsequent to the investigation, Pinnacle revised their simulator instructor guide[30] to include a single and double engine failure at FL350 during initial new-hire and captain upgrade training. Pilots would be expected to use starter assisted relight procedures with the single engine failure and windmilling relight procedures for the double engine failure. The dual engine failure would help familiarize pilots with emergency power only procedures and the effects of ADG deployment. The pilots would also be expected to start the APU as the airplane descended through FL300 in accordance with company procedures.

M. Stall Recovery Training

Stall recognition training[31] in the simulator was conducted at an altitude of 10,000 feet. Approaches to stalls were conducted in various airplane configurations and the autopilot was used during the approach to stall in the landing configuration[32]. The pilot initiated recovery at the first sign of a stall, usually the stick shaker. The intent of that

[28] See Attachment 2 for complete double engine failure procedures.
[29] See Attachment 1 for complete interview details.
[30] See Attachment 13.
[31] See Attachment 12.
[32] Landing gear extended and flaps set at 45 degrees.

training was to prevent the occurrence of a full stall. These approach to stall profiles were considered proficiency maneuvers and demonstrated that the pilot had mastered the airplane throughout its speed range and could initiate a standard recovery. It also provided the pilot the opportunity to use the appropriate control inputs and company callouts during the recovery.

The Bombardier chief pilot stated that decaying airspeed would be the primary occurrence that would precede a stall at FL410: He stated additional reasons as excessive turbulence, insufficient buffet margins, or excessive maneuvering.

A review of FDR data indicated that the airspeed decayed from 163/M.57 to 150 knots while the airplane was level at FL410. Additionally, the stick shaker activated about 20 seconds prior to the airplane entering the stall regime. The stick shaker activated four separate times prior to the FDR becoming non-functional.

The investigation determined that there was no simulator training conducted for high altitude stalls, full stalls, or recovery from full stalls. However, the approach to stall training and recovery techniques conducted during Pinnacle's simulator training were typical at most Part 121 operators.

Subsequent to the accident, Pinnacle revised the simulator-training syllabus to include a high altitude stall demonstration and a stall buffet margin demonstration. Additionally, Bombardier, Inc., issued an All Operator Message[33] that stated in part:

Do not wait for the onset of continuous ignition or stick shaker before attempting a descent from an altitude where continued operation is not possible. Descend immediately.

In the event that a stick shaker / approach to stall occurs, the crew should expect that a deliberate loss of altitude will likely be required in order to restore the aircraft to a normal energy state and to prevent an aerodynamic stall and possible departure from controlled flight.

N. Gulfstream International Airlines

Gulfstream International Airlines began service as an on-demand charter airline in 1988. The company began Part 121 scheduled service as a regional airline in 1990 and had more than 170 scheduled flights each day servicing South Florida and the Bahamas using BE-1900 turboprop airplanes. The company had a code share alliance agreement with Continental Airlines, Inc., and they were doing business as a Continental Connection. Company headquarters was located in Fort Lauderdale, Florida, and was the parent company of Gulfstream Academy.

Gulfstream Academy was established by Mr. Thomas Cooper, the founder, president, and chief operating officer (CEO) of Gulfstream International Airlines. The Academy offered a Part 121 first officer training course that was conducted by Gulfstream International Airlines. The course took 12 weeks to complete and included ground school, simulator training, and flight training in the BE-1900. Enrollment qualifications included a

[33] See Attachment 7.

commercial pilot certificate, instrument rating, and a multi-engine rating. Upon graduation, a pilot was guaranteed 250 hours as a paid first officer for Gulfstream International Airlines. The first officer training course helped to fill vacancies left by Gulfstream International Airlines pilots who had accepted employment with other airlines.

In 2002, Pinnacle Airlines began hiring a percentage of their new-hire first officers from Gulfstream International Airlines. They hired the first officers who had completed the first officer training program at Gulfstream Academy. Pinnacle considered it advantageous to hire those pilots because they had Part 121 experience and they had learned in a structured training environment. Pinnacle Airlines hired them with less total flight time than would have been acceptable for candidates who had a different background. The total flight time requirements for Gulfstream Academy graduates was dependent on the applicant but generally, 500 hours was considered the minimum. Other new-hire candidates were required to have 1500 total flight hours and 300 hours in multi-engine airplanes.

Based on company records reviewed during the investigation and interviews with instructors and checkairman, it was determined that the Gulfstream Academy pilots did not experience any particular problems as they progressed through Pinnacle's new-hire training syllabus. Even though they had less total flight hours than other new-hire first officers, there was not an increase in the overall failure rate in either ground or flight training.

O. Simulator Demonstration

On October 21, 2004, the Operations Group observed the following profiles and procedures in the CL-65 simulator located at the Pinnacle Airlines Training Center in KMEM:

1. Normal climb and airspeed crossover from 290 knots to M.74.
2. Cockpit indications and alerts for an over speed condition.
3. Windmill start procedures following a single engine failure at 24,000 feet.
4. APU start following a single engine failure at 19,000 feet.
5. Memory items and relight procedures following a dual engine failure. Both engines restarted using windmill procedures resulting in an altitude loss of about 6,500 feet.
6. APU start procedures following a dual engine failure. Both engines restarted with an altitude loss of about 3,000 feet.
7. Stalls in various configurations with / without the autopilot engaged.
8. Glide and landing with both engines inoperative. Speed 160 knots; rate of descent 1,500 feet per minute.

P. Weather

The Jefferson City Regional Airport (KJEF) was the closest airport to the accident site and the airport where ATC was attempting to vector the accident flight. The following weather had been reported at KJEF about the time of the accident:

Automated weather observation at 0253Z: wind from 290 degrees at 6 knots, visibility unrestricted at 10 miles, ceiling overcast at 4,400 feet, temperature 10 degrees C,

dew point 5 degrees C, altimeter 29.63 inches of Hg. Remarks: automated observation system, sea level pressure 1002.5-mb, temperature 10.0 degrees C, dew point 5.0 degrees C, 3-hour pressure tendency indicated rising then falling pressure 0.0-mb[34].

Q. Company Information

Pinnacle Airlines, Inc., formerly Express 1 Airlines, was founded in 1985. It was a wholly owned subsidiary of Northwest Airlines, Inc., and operated a fleet of 110 CRJs from three hub/crew bases located in KMEM (corporate headquarters / main base of operations), KDTW, and KMSP. Pinnacle Airlines provided service to numerous cities in the United States and Canada. The airline employed over 800 pilots, 29 dispatchers and about 500 flight attendants.

R. FAA Oversight

The MEM FSDO was responsible for oversight of the Pinnacle Airlines air carrier certificate.

An interview was conducted with Mr. Alton Josephs who was the previous principal operations inspector (POI) assigned to the Pinnacle certificate from 1986 until February 2003. He was the POI when Pinnacle began the integration of the CRJ into their fleet in 1998. In August 1998, an aircrew program manager (APM) was assigned to the Pinnacle certificate as part of the aircrew designator examiner (ADE) program. The APM was responsible for oversight of the certification activity and surveillance of the training program.

Mr. Josephs attended Pinnacle's CRJ training program in 2000 but was unsuccessful in his attempt to obtain a CRJ type rating. In September 2001, Mr. Barry Stanley, who had a type rating in the CRJ, was assigned as the assistant POI for Pinnacle Airlines.

In February 2003, Mr. Josephs was removed from the POI position because he did not have a CRJ type rating. The Southern Region's Division manager and a former MEM FSDO manager stated that Mr. Josephs had always provided adequate oversight for Pinnacle Airlines and was only removed from the POI position because he did not have a CRJ type rating. Additionally, a letter[35] from the Southern Region's Division manager to Mr. Joseph's stated in part that, "Mr. Josephs was being removed as the POI because he did not have a CRJ type rating, he did not provide proper guidance to Pinnacle in regards to formulating an acceptable training program and he lacked an FAR Part 121 background." The former FSDO manager added that Mr. Josephs had always received favorable performance evaluations from his supervisor and his removal from the POI position was not related in any way to poor job performance.

Mr. Robert Cowell, supervisor of the Pinnacle certificate management unit (CMU), stated that when he was assigned to the CMU in October 2002, he asked the POI, principal maintenance inspector (PMI), and principal avionics inspector (PAI) assigned to the Pinnacle certificate to not conduct any additional surveillance at the carrier. He appointed

[34]For further information, see the Meteorology Group Chairman's Factual Report.
[35] See Attachment 39.

temporary inspectors to those positions with the intent of having a "fresh set of eyes" evaluate the company's compliance with the federal aviation regulations (FARs). He stated that part of the problem between Pinnacle Airlines and the FAA was that the company appeared to be "disrespectful" of the FAA. They gave the appearance of not paying much attention to FAA requests. Additionally, he said there were difficulties with the oversight of the training program, which needed to be reviewed, updated and made more readable and user-friendly. There were also a number of revisions that needed to be incorporated into the program. He stated that he wanted to get a new start with the carrier and had elected to put new temporary principal inspectors in place to do that. The carrier agreed to improve their attitude and work with the new principals.

During December 2002, the Saab airplanes were completely phased out of the Pinnacle fleet and they operated only CRJ airplanes. Mr. Cowell stated that, since Mr. Josephs did not have a CRJ type rating, he was removed from the POI position in February 2003.

Following Mr. Josephs' removal from the POI position, there were three acting POIs, including the Pinnacle CMU supervisor, assigned to the Pinnacle Airlines certificate from February 2003 until July 2004. The CMU supervisor said that the POI position was not permanently filled until July 2004 because of potential equal employment opportunity (EEO) concerns regarding Mr. Josephs' reassignment.

The FAA POI currently assigned to the Pinnacle Airlines certificate was recently appointed to that position in July 2004. He was assigned as the assistant POI on the Pinnacle Airlines certificate in July 2003 and remained in that capacity until he attended five months of training at the FAA academy in Oklahoma City, Oklahoma, that began in January 2004. Shortly after his return from the academy, he was permanently assigned the POI position for Pinnacle Airlines. He currently had two assistant POIs to help with his workload.

Integrated Safety Information Subsystem (ISIS) inspection reports provided by the FAA and an interview with the current MEM FSDO manager indicated that the MEM FSDO conducted the FAA Southern Region's required surveillance inspections ("R" Items) and the FSDO generated planned surveillance items ("P" Items) at Pinnacle in accordance with FAA's policies and procedures.

From January 1, 1998, until October 21, 2004, the FAA filed a total of 59 violations against Pinnacle Airlines. Fines were levied in seven of the violations. The FAA closed the other violations following administrative actions.

S. Department of Defense (DOD) Inspection

Personnel from the DOD Commercial Airlift Review Board (CARB) conducted an on-site survey at Pinnacle Airlines from July 21, 2003, thru July 25, 2003. It was discovered that DOD notification procedures were not included in the company's emergency response plan. The company immediately corrected that deficiency before the survey was completed on July 25 and that was the only deficiency discovered by the survey team in the area of Company Operations.

T. FAA Evaluation of Pinnacle Airlines

From December 4, 2001, through December 14, 2001, personnel from the MEM FSDO, Southern Region Flight Standards and a Certification/Standardization/Evaluation Team (CSET) evaluated Pinnacle Airlines. It was a focused inspection that targeted specific certification requirements of the airline. The FAA's 90-Day Safety Review conducted in 1996 recommended a project to make surveillance and evaluations of air carriers more systematic and targeted to deal with identified risks. Pinnacle's evaluation was intended to carry forward that recommendation.

According to Pinnacle's CMU supervisor, he reviewed the evaluation when he became supervisor in October 2002. He stated that the principal inspectors should not have accepted the answers the company provided in regards to some of the findings. He said the findings were closed when the company did not actually make the necessary corrections but only promised to make the corrections at a future time. He said that was not acceptable. Letters were sent to the company outlining the issues in question and they immediately began corrective actions. All findings were closed in 2003 and the final report[36] was issued on September 25, 2003.

Submitted by:

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Dave Kirchgessner
Air Safety Investigator, Operations
January 18, 2005

[36] See Attachment 16.